



NASA Ames Water Recycling Technology Development

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Advanced Life Support



Objective:

Keep Astronaut alive

Provide habitable environment

Reduce Cost

International Space Station



Mars



Inputs

Water

Oxygen

Waste
Collection

Temperature
Control

Pressurized
Environment

Energy

Outputs

Waste
Water

Carbon
Dioxide

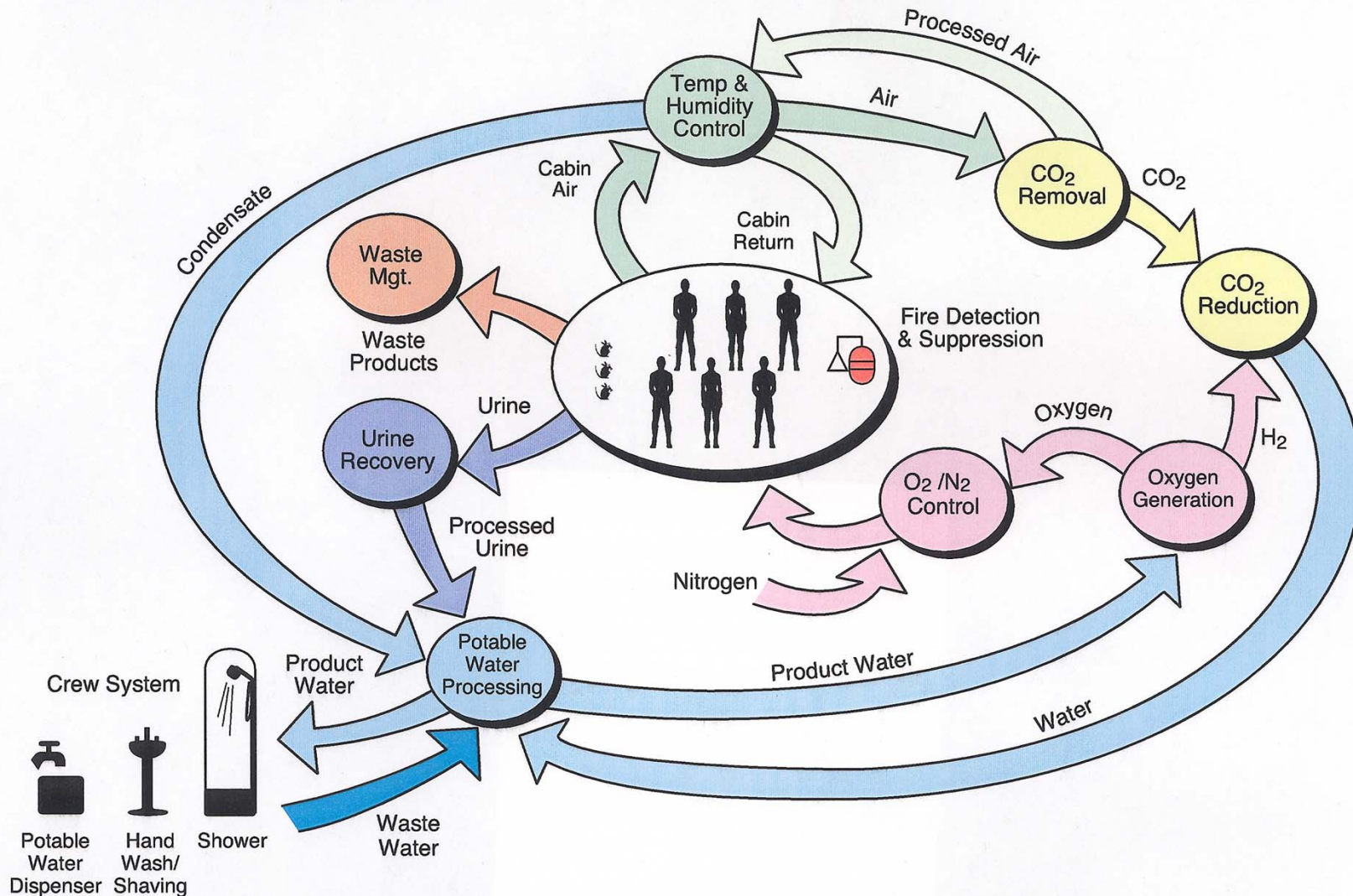
Volatile
Organics

Solid
Wastes

Heat

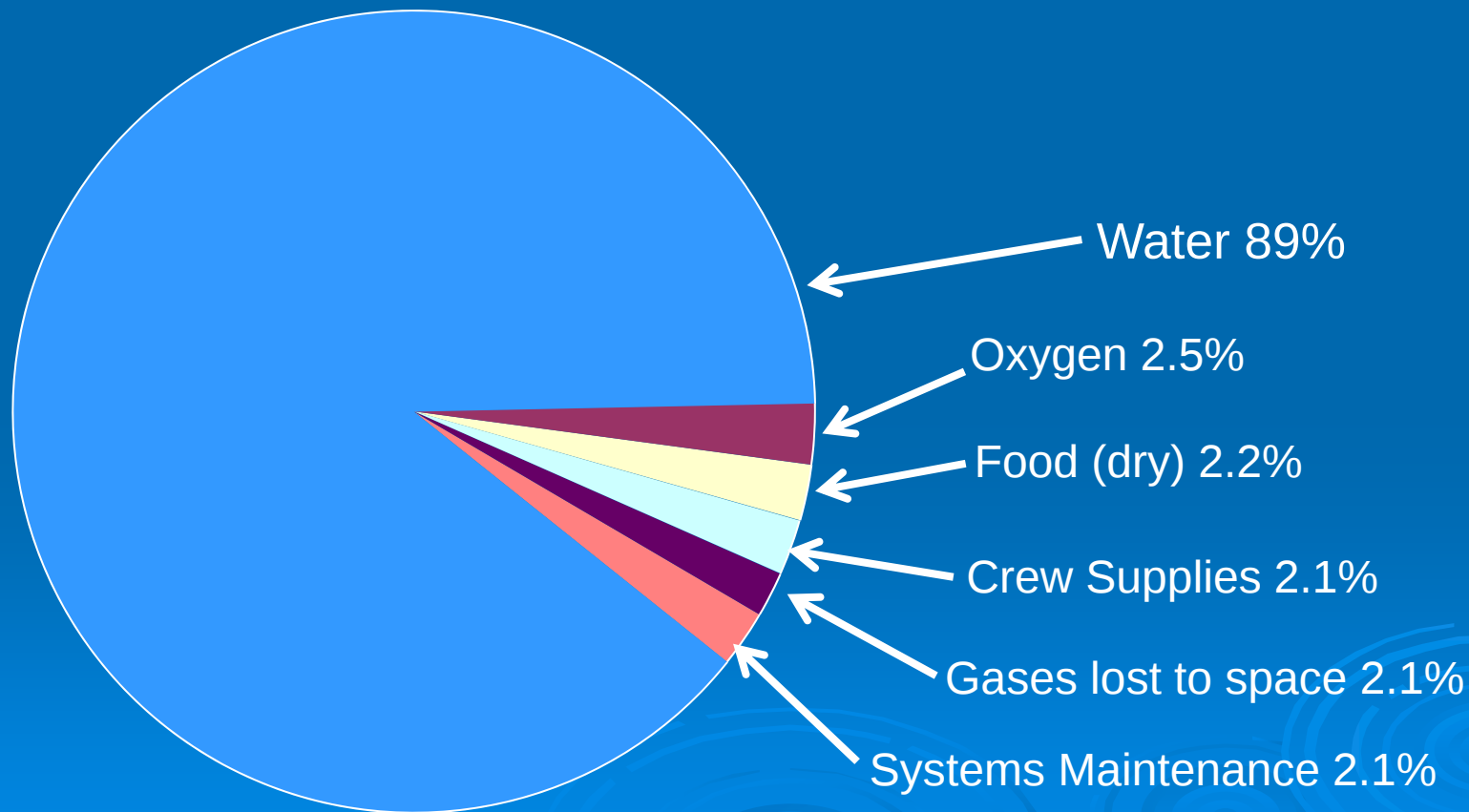


Space Station Regenerative ECLSS Flow Diagram (Baseline and Scarring)



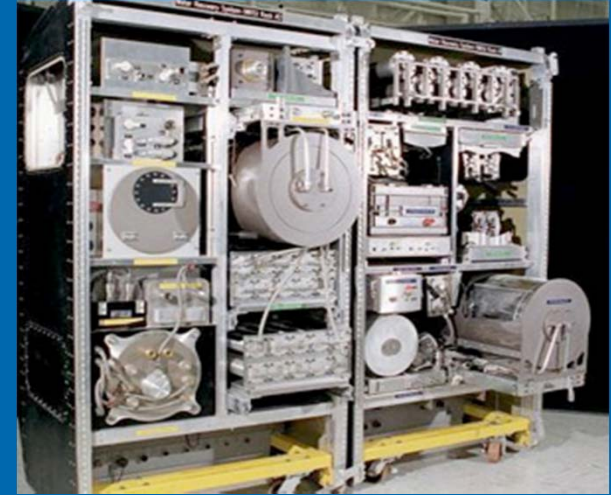
Life Support Requirements

Open-loop life support system re-supply mass



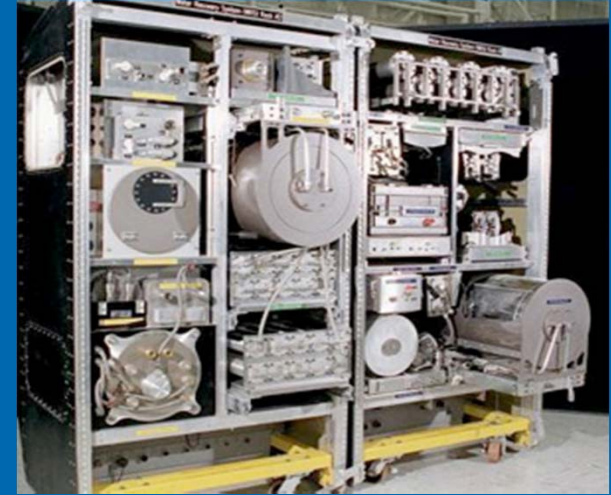
ISS US Water Processing Assembly

- Wastewater is recycled using distillation, adsorption, and oxidation.
- Urine, hygiene, and condensate are recycled to drinking water.



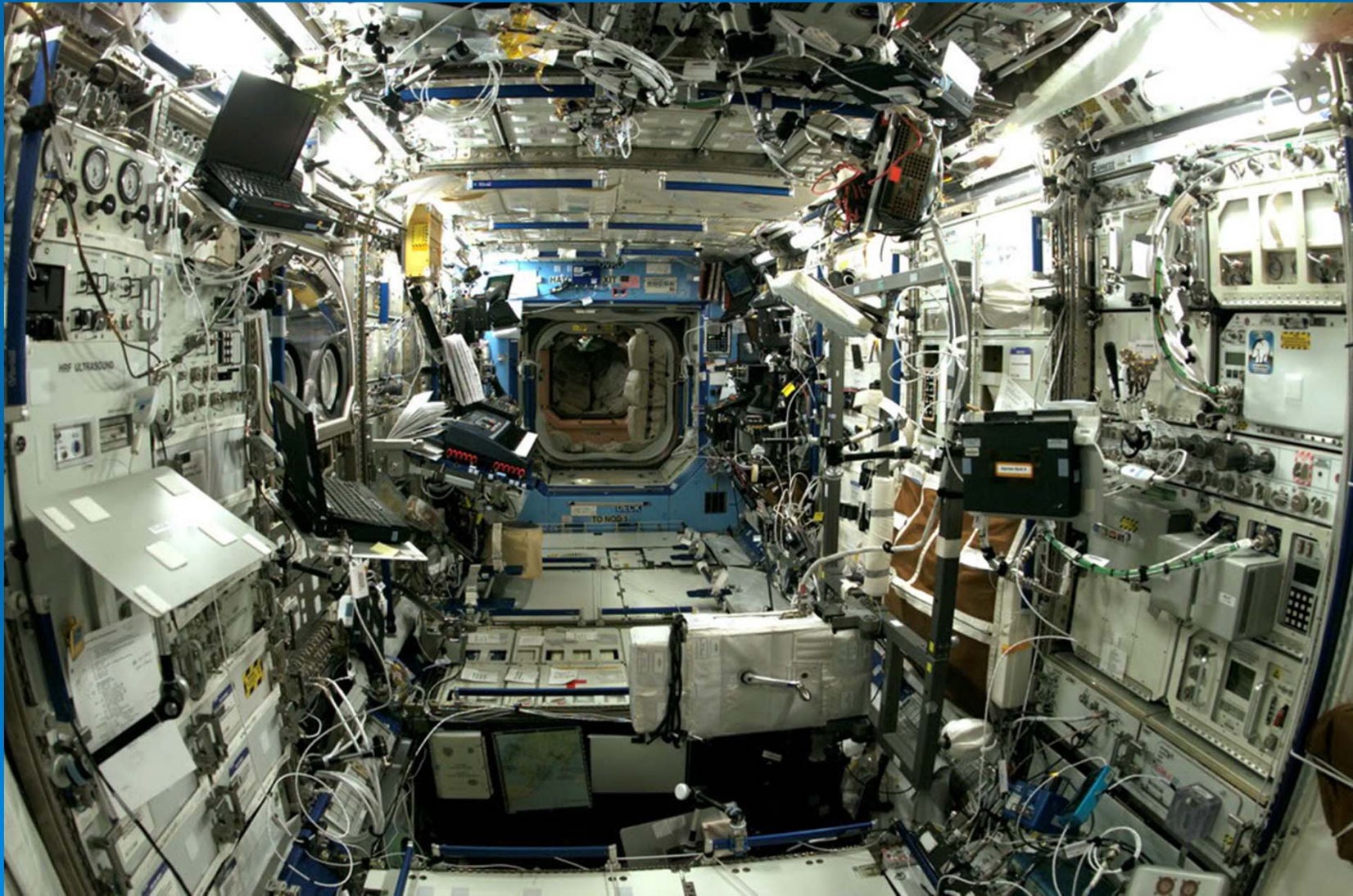
ISS US Water Processing Assembly

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Concept to Practice

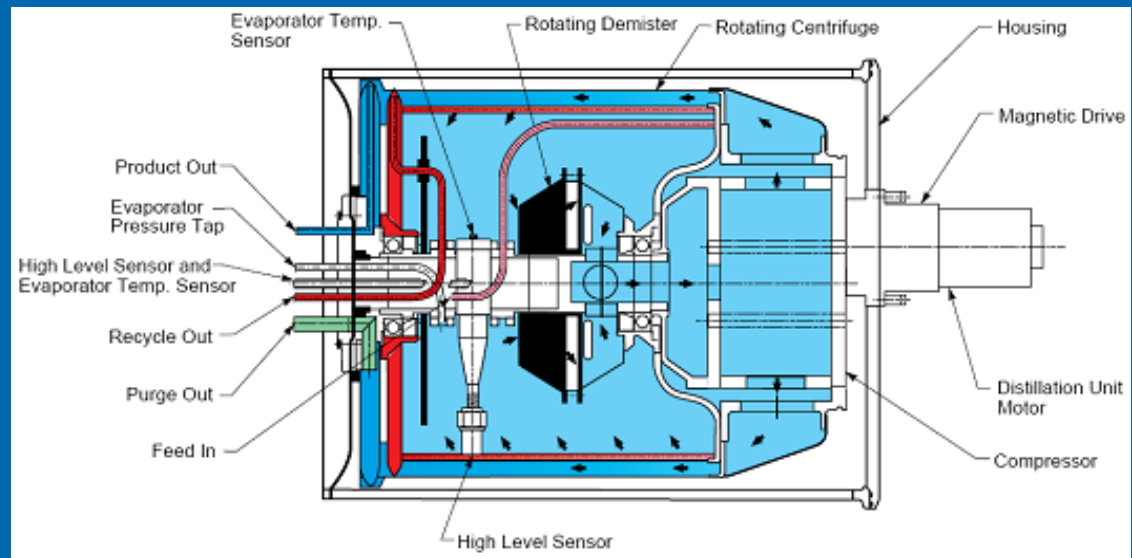
It is one thing to talk about what could be done but entirely another to make it work



ISS Urine Processing Assembly

Based on vapor
compression distillation

Susceptible to calcium
scaling

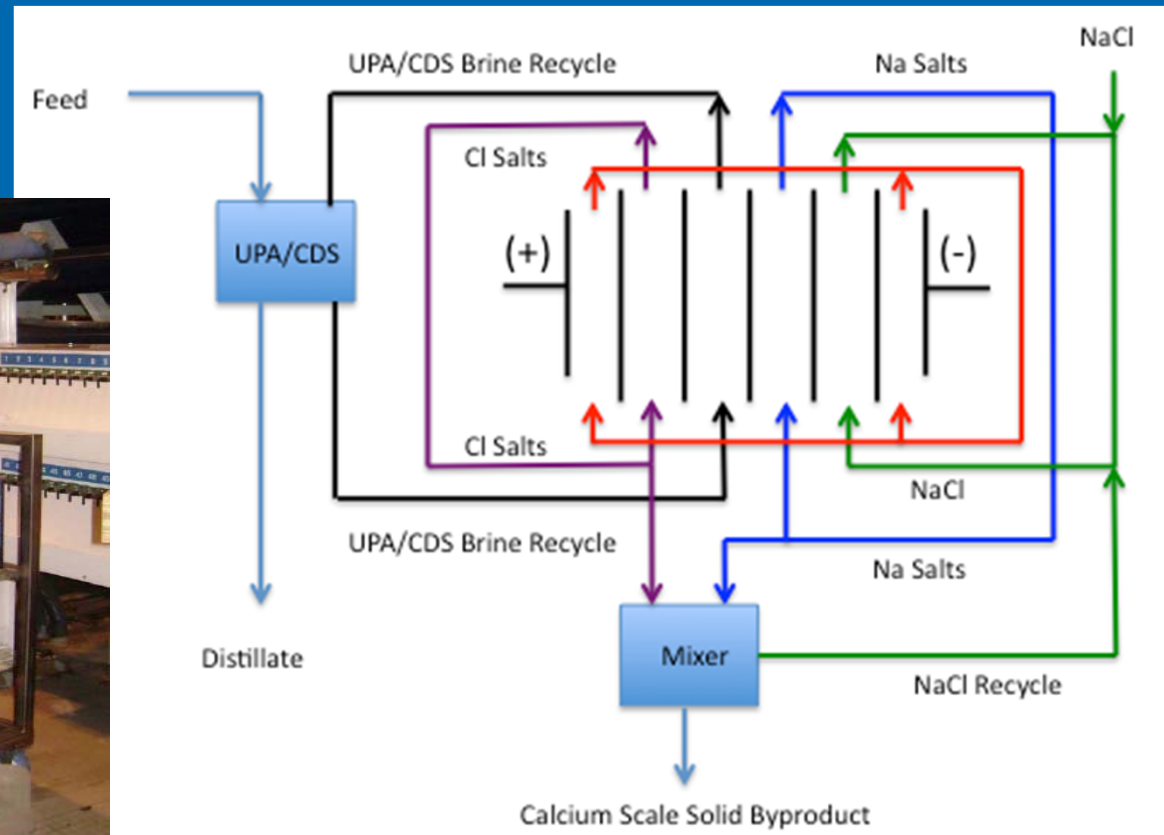


Two types of calcium
sulfate scale

Electrodialysis Metathesis



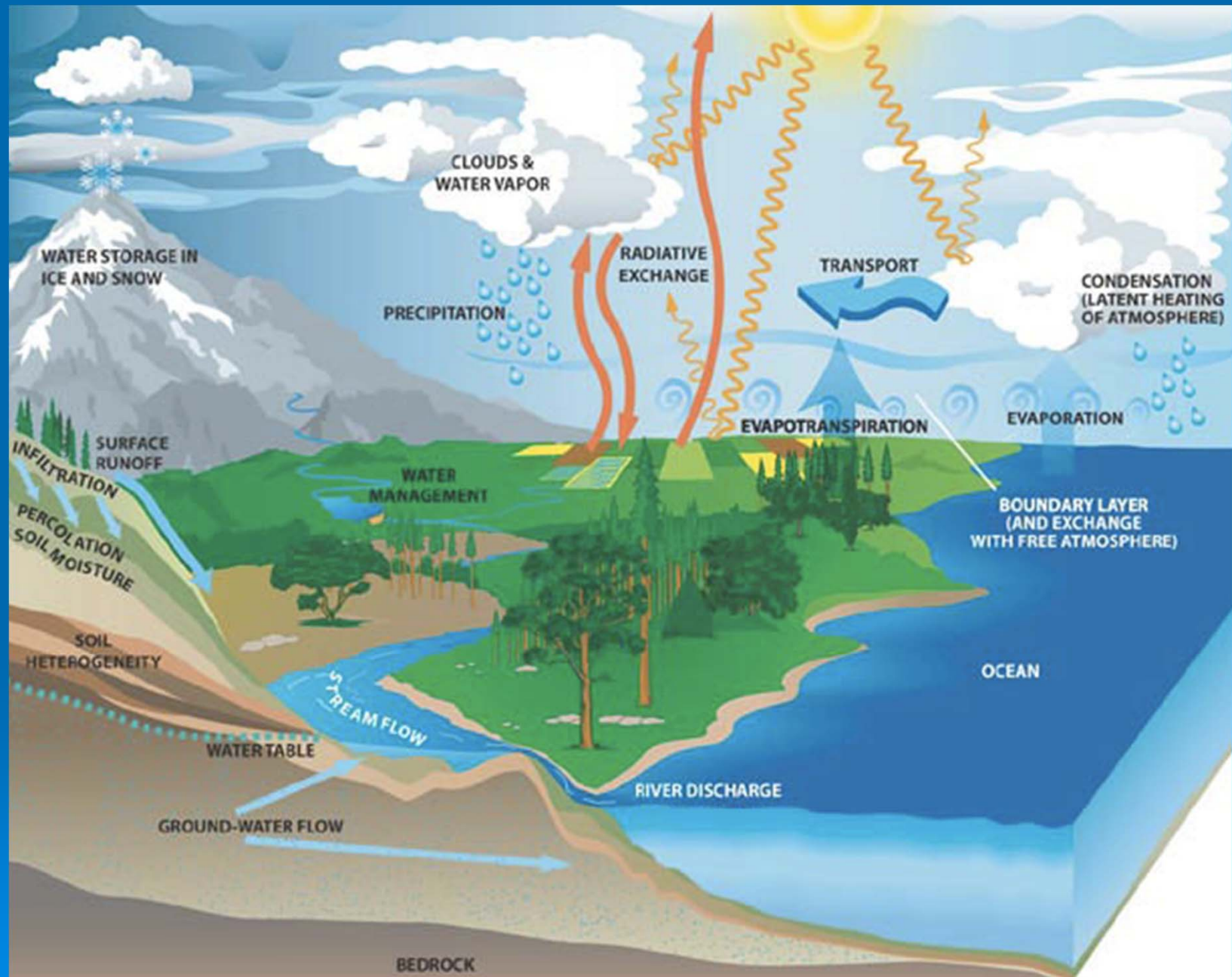
EDM test stand



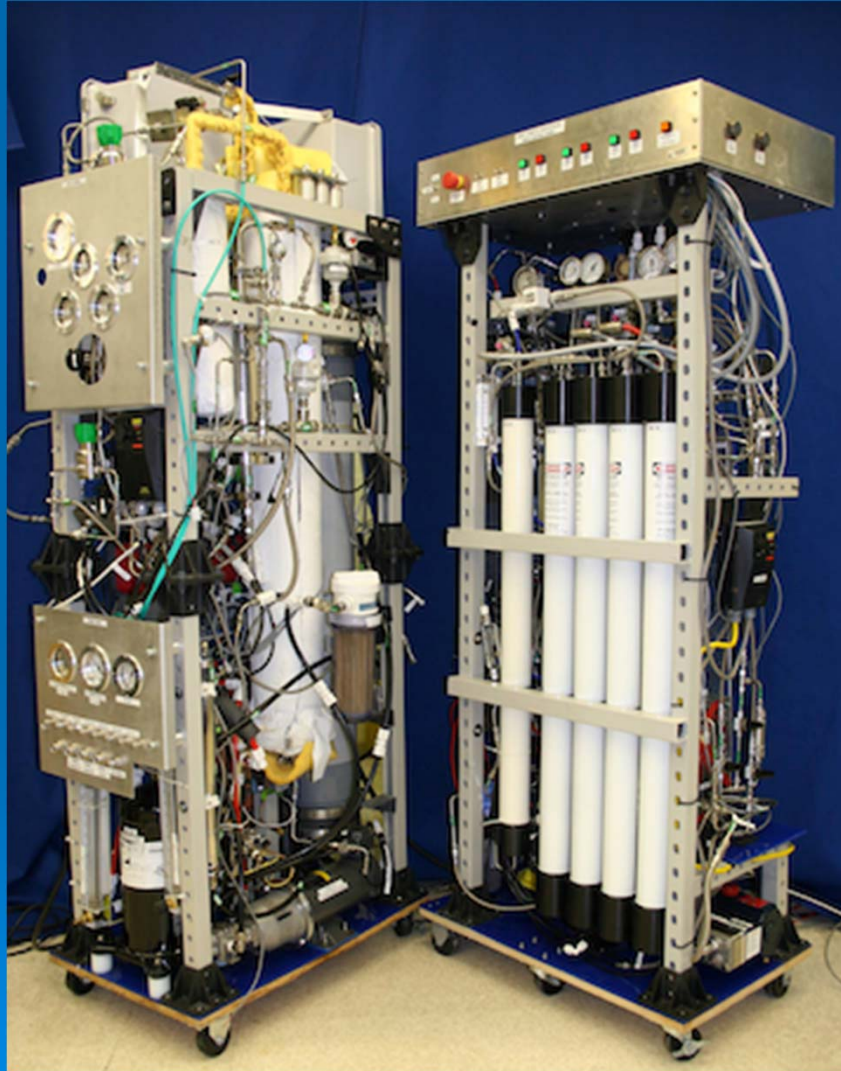
EDM Flow Diagram

Vapor Phase Catalytic Ammonia Reduction

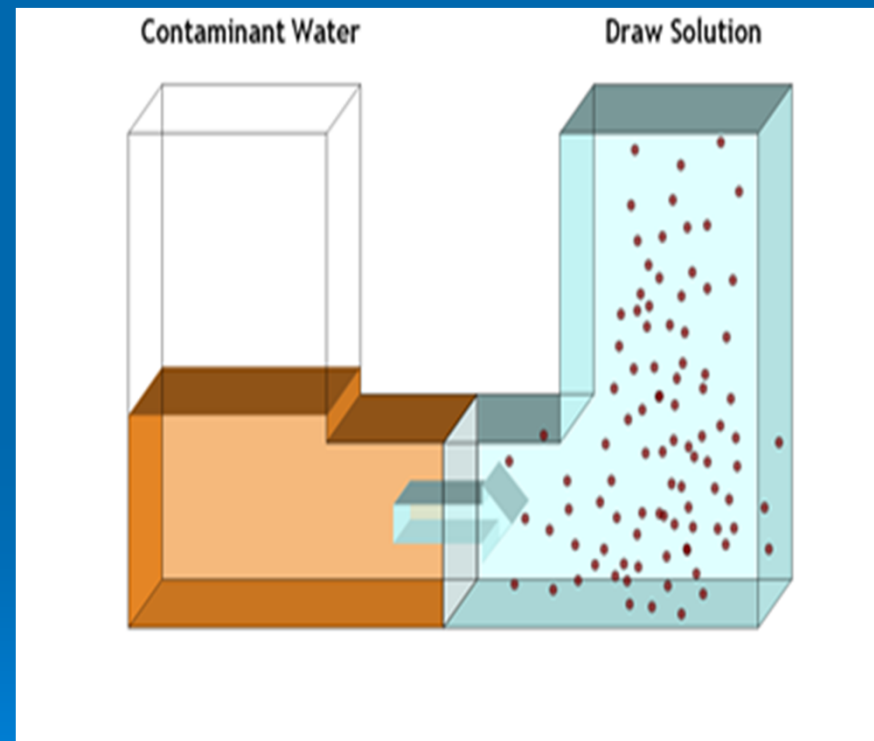
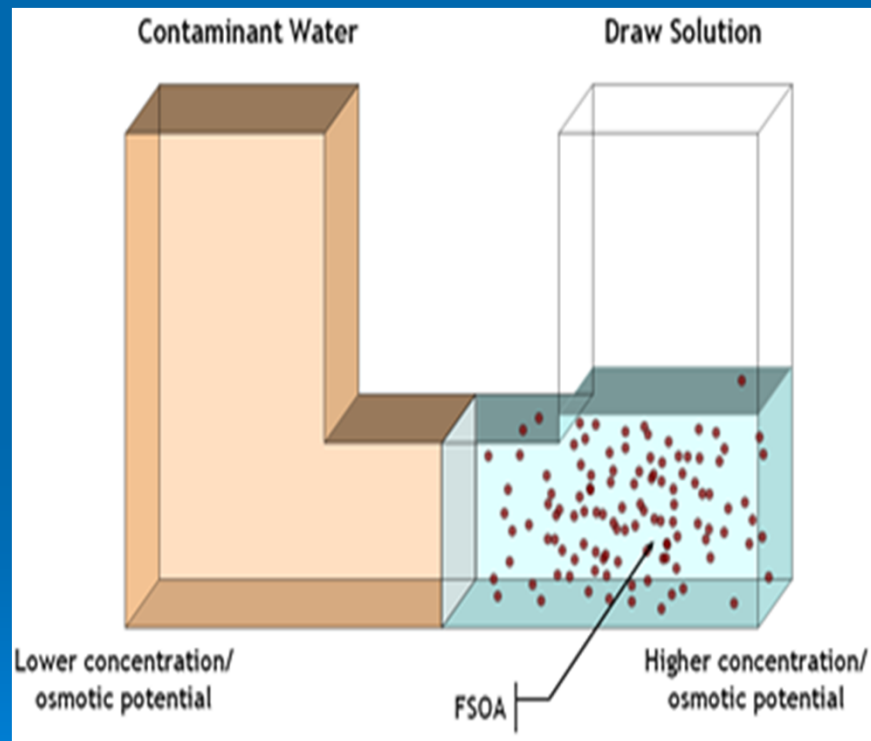




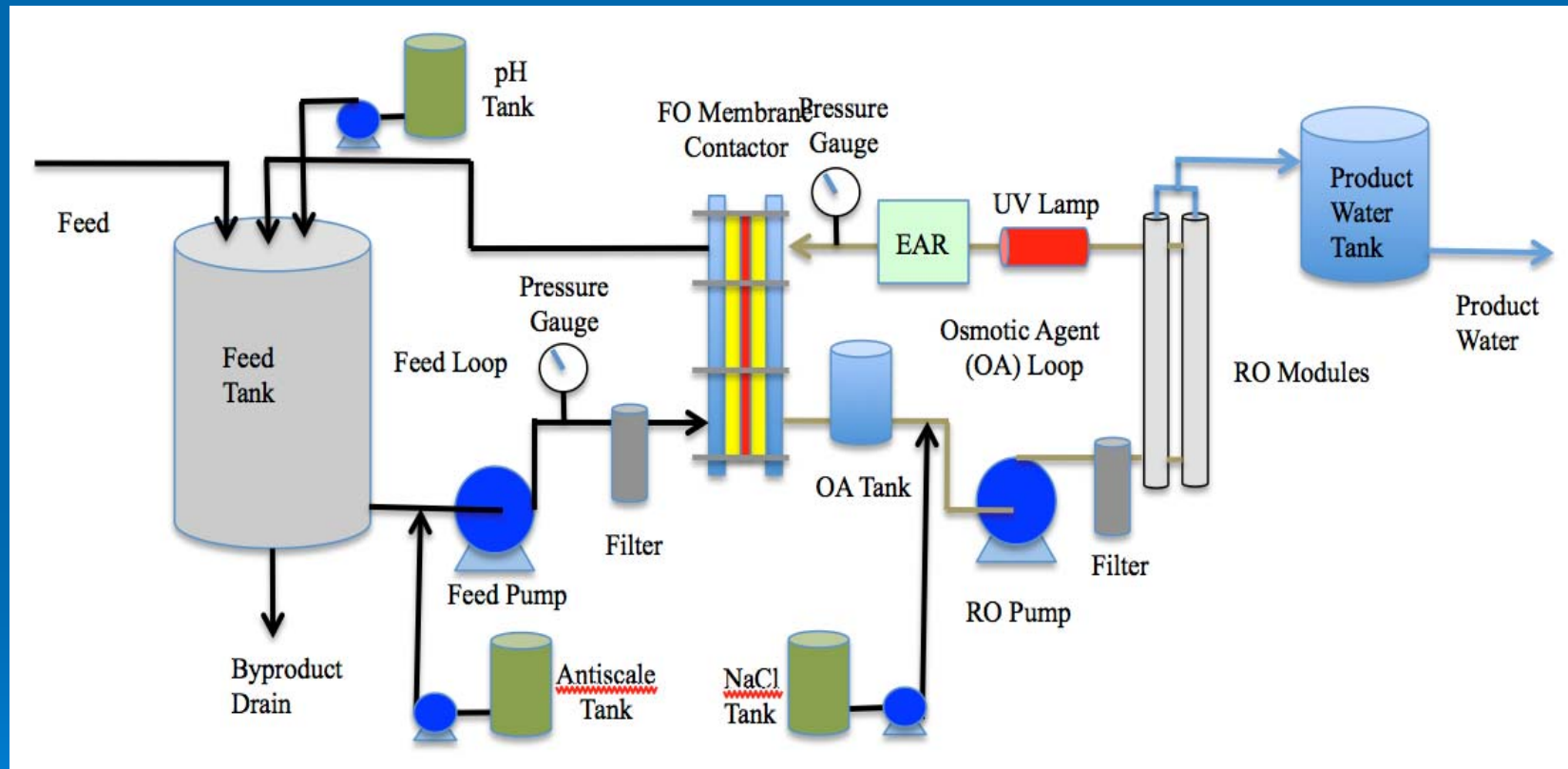
Forward Osmosis



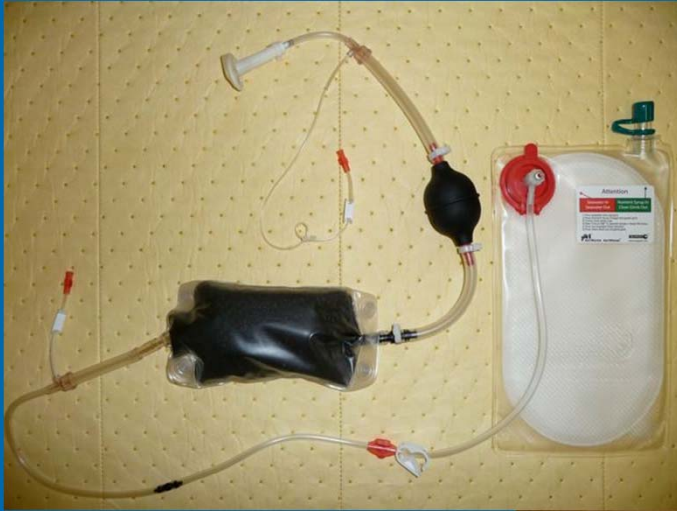
Forward Osmosis



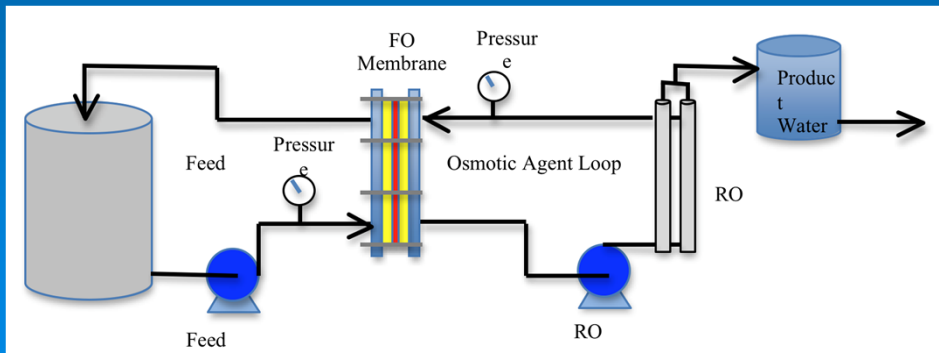
Forward Osmosis Secondary Treatment



Light Weight Contingency Water Recycling System



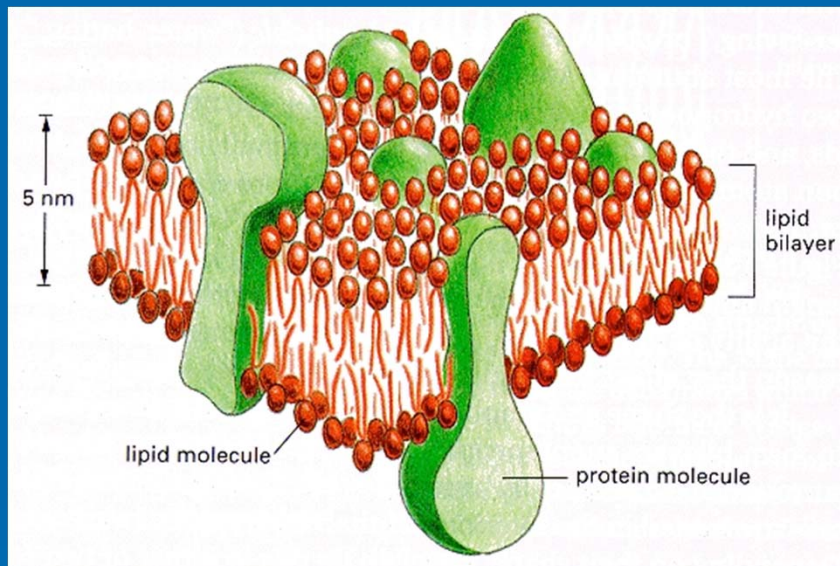
Graywater Recycling



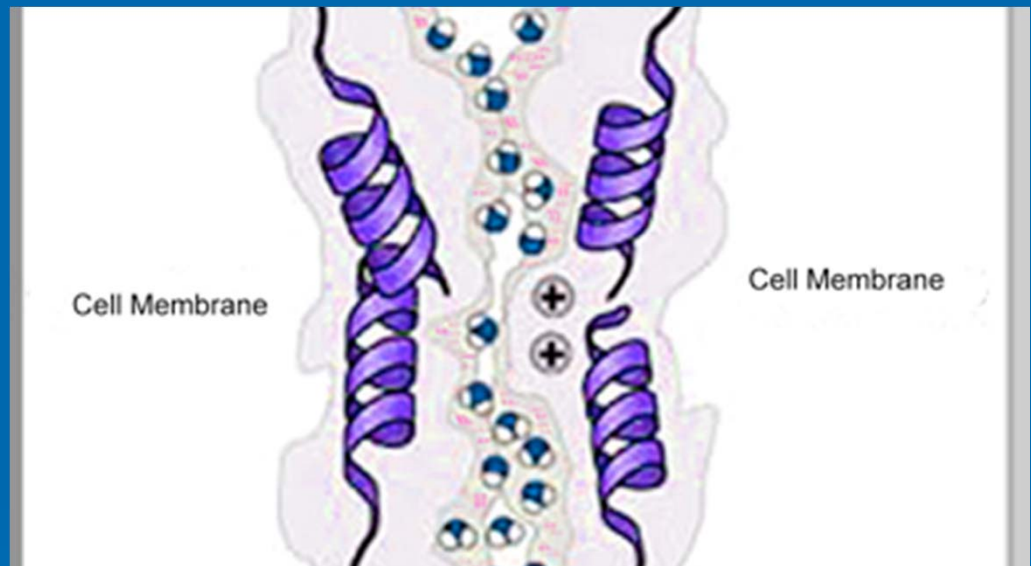
Osmotic Distillation



Advanced Membranes



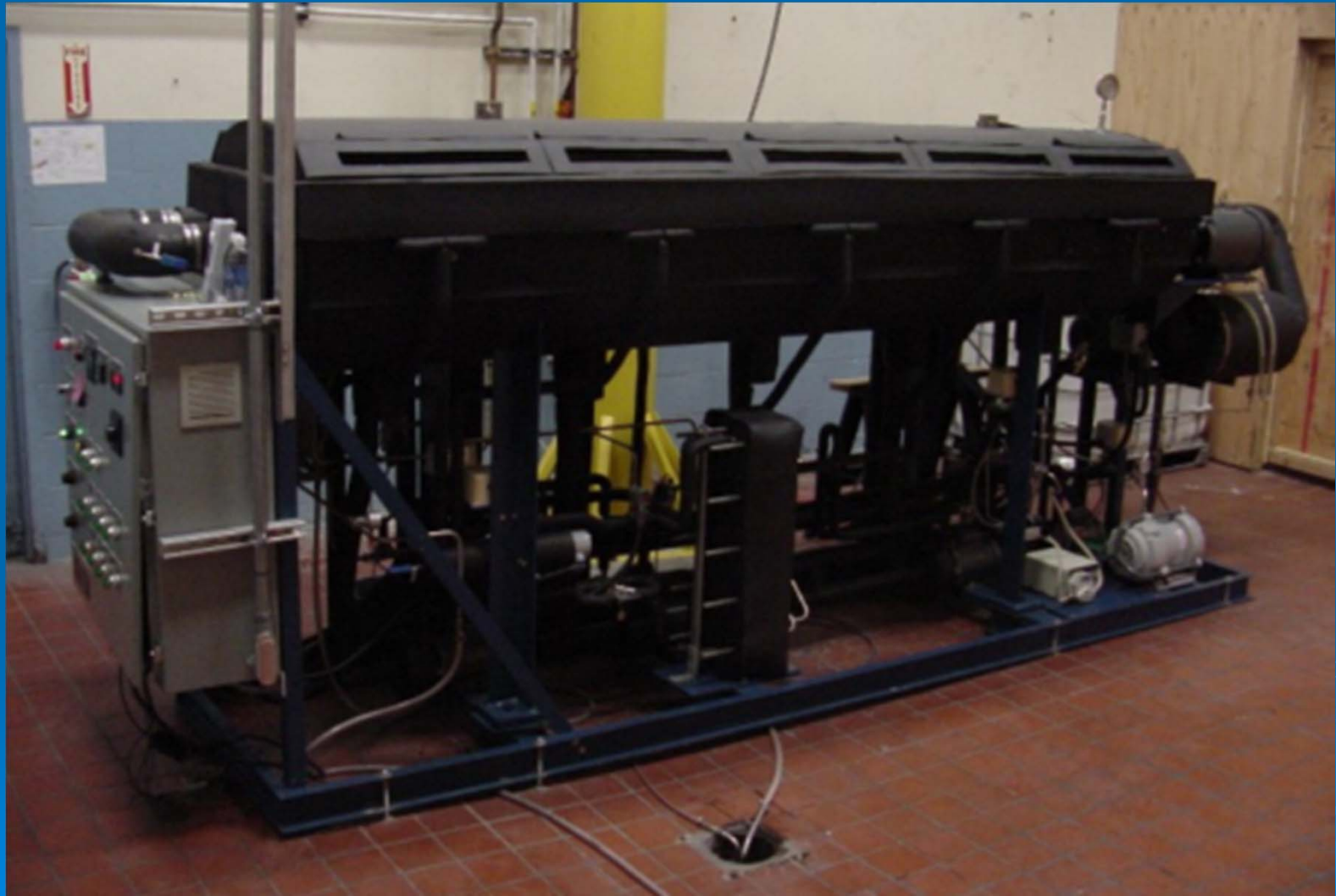
Lipid Bilayer Membranes



Aquaporin Embedded Protein Membranes

Glass Membranes, Nano-tube Membranes, Osmotic Solids, and Novel Backings

Food Processing



Wiped Film Rotating Disk Evaporator

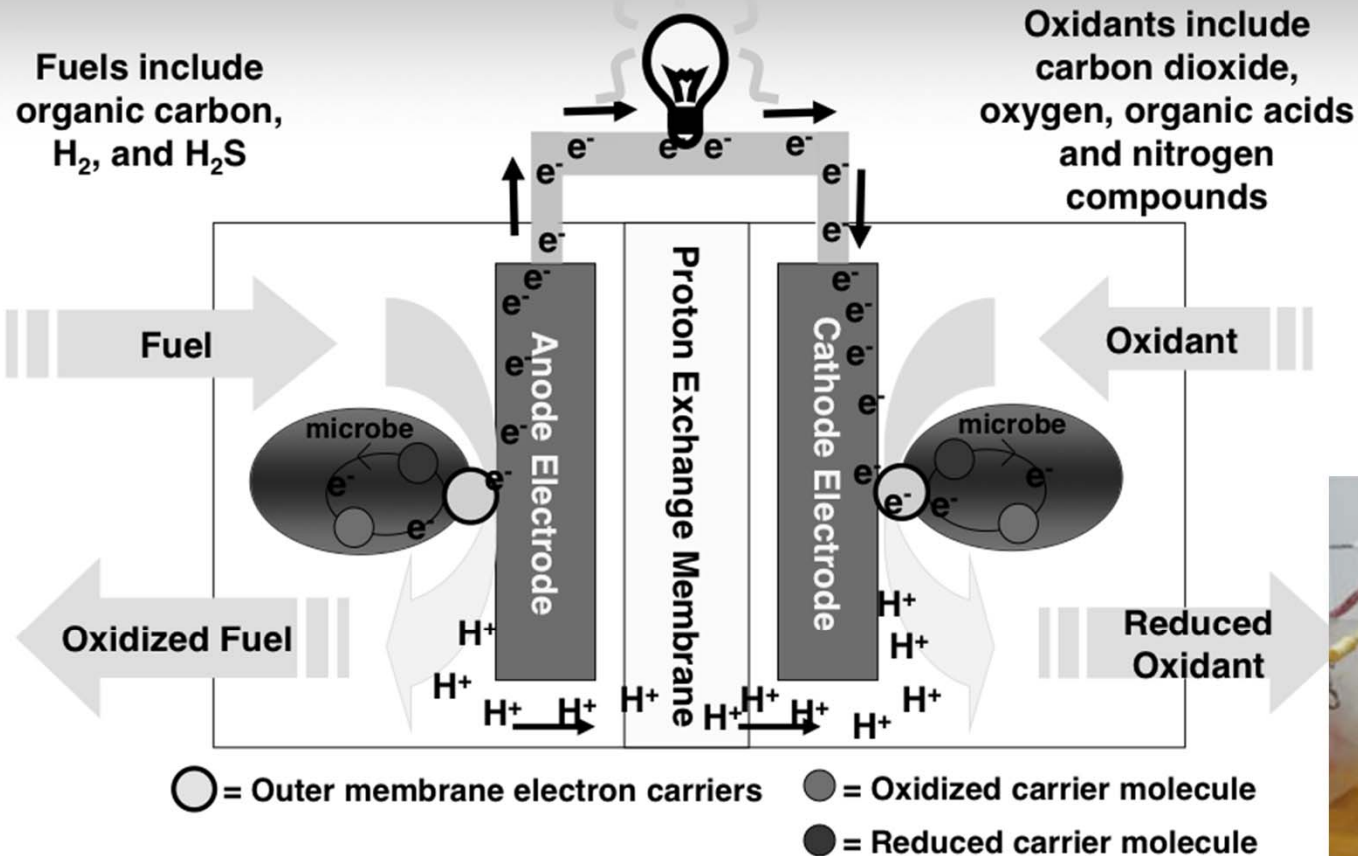
Seawater Desalination



Environmentally Sustainable Desalination

Biological Fuel Cells

Microbial fuel cell - a version of BES



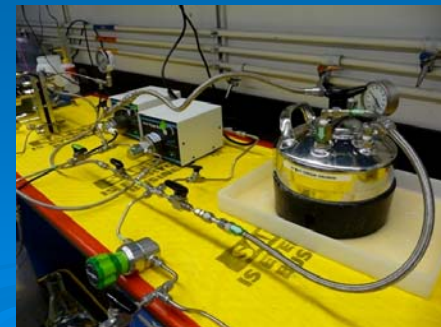
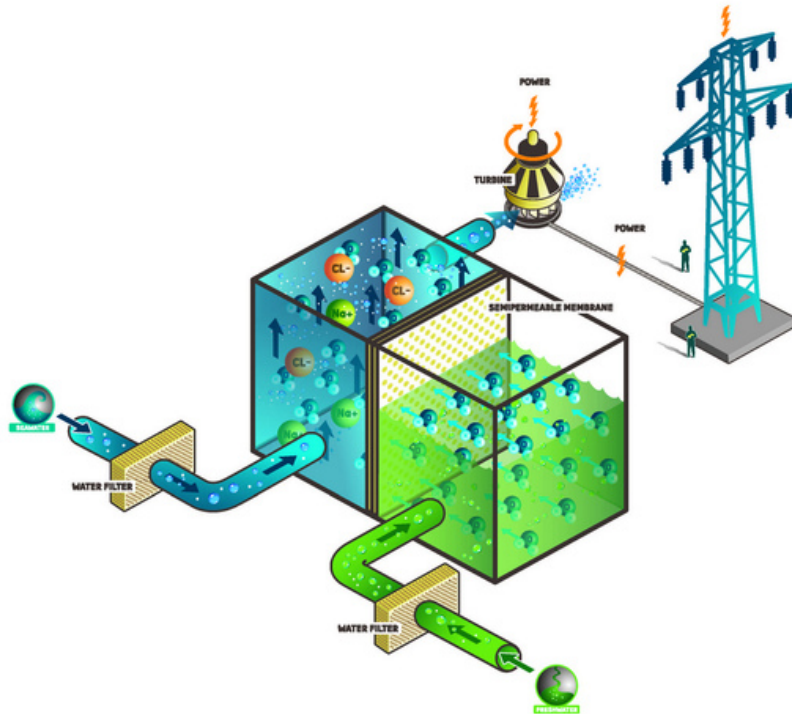
J. Craig Venter

I N S T I T U T E



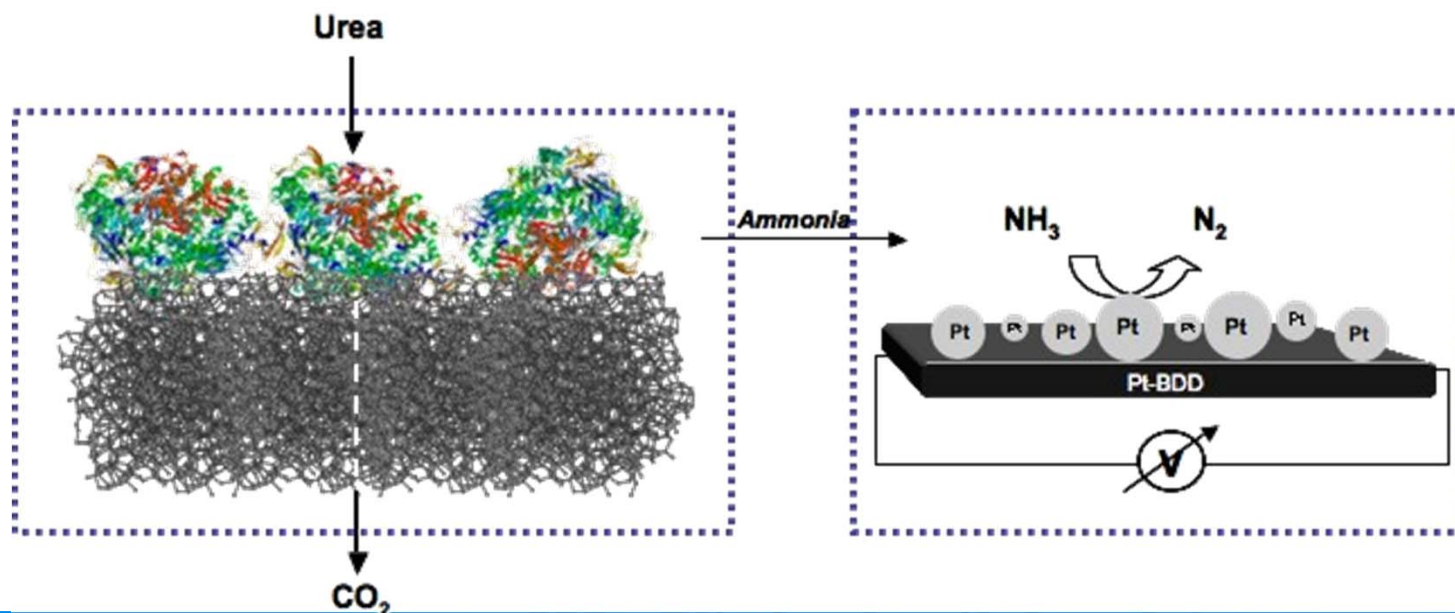
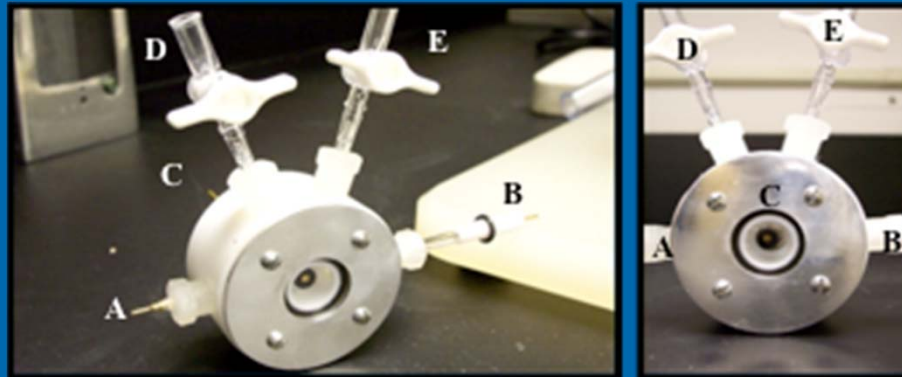
Osmotic Power

→ SEMIPERMEABLE MEMBRANE



Ammonia Fuels and Cells

Urea Biofuel Cell Reactor for Water Purification



Water Recycling for Third World Applications

